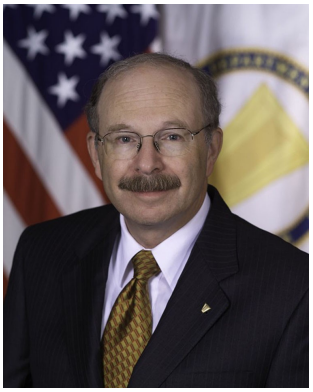
MANPRINT
Newsletter
Spring/Summer 2006

The Director's Corner



In the MANPRINT Directorate, we are very proud of the job that all of the MANPRINT community does to make sure that developing systems meet key soldier standards. The Army MANPRINT program, although transforming, is well known to most readers of this newsletter. Many in the community, however, are less aware of the Human Systems Integration (HSI) connections between us and our sister Services.

For several years we have been very much in the eye of the House Armed Services Committee. At least one member of the Committee and a staff member have a wonderful appreciation of what HSI does and its importance in reducing lifecycle costs of systems. As a result of this benign interest, there have been a series of congressional earmarks that have provided the means for better HSI tool development. More recently, the HASC has asked the Department of Defense to produce a series of reports for the Committee and to then have these reports reviewed by a committee of the National Defense University.

The first of these reports, prepared by all the Services, but with the Army in the lead, has now been forwarded to Congress by Dr. Chu, the Under Secretary of Defense for Personnel and Readiness. I plan to make the report available on our web site soon. We recommended, and Dr. Chu concurred, that there be a Joint HSI Steering Group at the one-star level with representatives of all the Services, including the Marines. Dr. Chu will soon issue a letter that will call on the Services to appoint members to the Steering Group. The purpose of the JHSISG will be to address systemic HSI issues and serve as a forum for discussions on R&D funding for HSI tools and methodologies. I believe that the JHSISG will offer us the advantages of acquiring a better connection to OSD and of better positioning the Service HSI organizations to influence future OSD and Joint Staff acquisition regulations and policy.

The next report to Congress will contain more information on HSI success stories, review HSI efforts on existing systems, and list issues that hinder more effective implementation of HSI in acquisition programs. Although we, with all of your help, will develop the list of HSI hindrances, the final report will only contain those with which Dr. Chu concurs. Dr. Chu is a very strong supporter of HSI, and he is as eager as us to see it applied more effectively.

The Army again has the lead for this report, but it can not be done without the significant aid of the other Services. After the next report, the NDU will convene a committee to evaluate the reports and forward their evaluations to Congress.

These are really exciting times to be in HSI. Not only do we have the Congressional interest in helping us do our jobs better, but we also have rapidly developing HSI programs in our sister Services. Elements of these programs are often based on the

Michael Andrews
Director for MANPRINT

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MANPRINT ON THE BEACH
The World's First Master's Degree in Human Systems Integration (HSI)

By Josh Kennedy
US Army Research Lab

Since its inception nearly 20 years ago, the MANPRINT/HSI field has been lacking a formal, university-driven education process for dedicated practitioners in the field that focuses on domain and systems integration. Thus I was pleased to be asked to share my experiences as a student in the world's first, and so far only, HSI master's program. Beginning with a cohort of seven students in January 2004, the U.S. Naval Postgraduate School (NPS) in Monterey, CA recently awarded the world's first Master of Science (M.S.) degree in HSI after a comprehensive and demanding 24-month curriculum. If you were going to institute a master's degree for HSI, what better place to do it than right next to the beach in coastal California.

HISTORY

Located in Monterey since 1947, NPS is an academic institution whose emphasis is on study and research programs related to the Navy's interests, as well as to the interests of other branches of the U.S. Department of Defense. The programs are designed to accommodate the unique requirements of the military. Its mission is to provide relevant and unique advanced education and research programs that increase the combat effectiveness of the U.S. and Allied armed forces, and enhance the security of the United States. NPS offers a full array of degree programs and certificates, with a focus on master's degrees and some doctoral degrees.

Command. The original program architect at NPS is Dr. Nita Miller, who almost single-handedly dragged the HSI curriculum through the NPS Academic Committee and into existence.

NOT YOUR AVERAGE GRAD SCHOOL

As you might guess, going to NPS is definitely not your typical graduate school experience. First of all, the school's 1,500 students are almost entirely military officers from the US, as well as Allied countries, with a small smattering of DoD civilians, and even a few US defense contractors. The typical student is a military officer, age 30-32 years, married with 1-3 children, and has about a decade of operational military (and combat) experience to draw from. There is a dress code for all students (business casual, no jeans or tennis shoes), and all military personnel wear uniforms every Tuesday.

The various master's curricula in the school, from engineering and sciences to national security affairs to acquisition and business administration, call for 2-2½ times the course load of other master's degrees in the country, plus a mandatory thesis (or equivalent) for all masters students. Depending on curriculum, each masters program lasts 18-24 months – period. Students are not allowed to spread out the course load over a longer time period, and leaving without having a thesis completed is rare and highly discouraged. Nearly all students take 4-5 classes per quarter and spend 16-20 hours per week in the classroom. Normal class preparation is two hours for every hour in class, with 2.5-3 hours needed for projects, presentations, written reports and

Continued from page 2

program. The school's HSI Laboratory (HSIL) is stocked with over $250,000 of equipment, including a motion capture system, an eye/head tracking system, and a flight simulator. The centerpiece of the HSIL is the Applied Warfighting Ergonomics (AWE) Center, a state-of-the-art usability testing facility for recording and analyzing individual performance data in lab and field applications. Students and faculty can empirically evaluate human-system performance issues with the same equipment being designed for warfighters.

The first cohort of students drafted for the HSI degree included four Army civilians from ARL/HRED and three US Navy lieutenants. Subsequent cohorts included more Army civilians from ARL/HRED, as well as US Navy and US Air Force officers. The program begins in January and lasts 24 months. NPS has a 4-quarter academic year, with a pair of two-week breaks in the summer (Independence Day) and winter (Christmas and New Years).

The HSI curriculum at NPS advocates a human-centered approach in the design, acquisition, testing, and operation of complex man-machine systems. The 8-quarter curriculum takes an interdisciplinary approach. It addresses all of the various domains of HSI (especially human factors), as well as defense systems acquisition fundamentals and program management, test & evaluation, a strong sequence in applied statistical processes, systems engineering, and portions of the school's MBA curriculum. The degree culminates in a thesis that focuses on at least three of the HSI domains.

LIFE IN MONTEREY

NPS was a two-year adventure in every sense of the word. My family and I were living in southeast Alabama while working at ARL/HRED's Fort Rucker office when I was offered the opportunity to attend NPS. We sold our house, packed up our two small boys, and endured the cross-country move. We rented a great little house four blocks up from the Monterey Bay and downtown area. In a nod to Procrustes of Greek mythology, we jammed ourselves into our home for the next two years, or as we would joke, "Half the space at twice the price!" We can attest to the fact that Monterey's reputation for cost-of-living is well-warranted, but that's part of the adventure. I was able to regularly bike to NPS and we were within easy walking distance of the local library, playgrounds, restaurants, a movie theater, and the beach.

We immediately became acquainted with the comfortable facilities at the local hospital. The oldest of our boys (4 years old), broke his arm on the very first day in the house. I had to open up our new phone book to find out where exactly the hospital was located. Later in the year we had the occasion to visit the hospital for a few more days when our third son was born in October 2004. As expected, having three small boys in the house while attending NPS made the adventure all the more exciting.

Of course, the Monterey area is quite possibly as close to paradise as you can have in the USA. The Monterey Bay is lovely, the sunsets over Pebble Beach are just gorgeous, and the area is a veritable garden spot for all kinds of fresh food, including lettuce, strawberries, artichokes, and seafood.

Continued from page 3

there is plenty of nightlife downtown. Alas, as the parents of three small boys, we didn't get to know that scene very well.

So after our two-year adventure, we moved our crew back to Alabama, taking up a position with ARL/HRED's office at Redstone Arsenal. In the end, we came away with a great master's degree experience, plenty of California sunshine, a new child, and about 500 pounds of new books from all of the coursework.

Josh Kennedy is a Human Factors/MANPRINT practitioner with ARL/HRED. He is the MANPRINT lead for PEO-Aviation at the AMCOM Field Element in Redstone Arsenal, AL. He is a graduate of the US Military Academy at West Point. In addition to his new M.S. in HSI, he also holds a Master of Aeronautical Science (Human Factors specialization) from Embry-Riddle Aeronautical University. Josh is a rated Army aviator with active duty tours in the U.S., Egypt, Kuwait, and South Korea; he remains an Army Reserve officer. He is happily married to Kirsten and they are the proud parents of three young boys. He can be reached at josh.kennedy@us.army.mil, or 256-842-7937.

Meetings of Interest

MANPRINT Practitioners' Worksho
ubletree Hotel, Crystal City-National A
October 31 – November 2

DoD Human Factors Engineering
chnical Advisory Group (DoD HFE TAG) Meeting 5
Las Vegas, Nevada
15-18 May 2006

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ace and Missile Defense Conference and Exhibit
Von Braun Center
luntsville, Alabama
14-17 August 2006

Human Systems Integration in Unmanned Aircraft Systems

Maj Anthony P. Tvaryanas (311 HSW/PER)

Introduction

The 311th Human Systems Wing's Performance Enhancement Directorate (311 HSW/PE) is charged with assisting program managers within United States Air Force (USAF) aeronautical system centers in implementing human systems integration (HSI) during weapon system development and acquisition. Analogous to the recent emphasis on evidence-based decision-making in medicine, 311 HSW/PE patterns its activities after those of an evidence-based practice center, reviewing the scientific literature and available data and providing evidence-based HSI assessments. One of the more challenging areas for 311 HSW/PE is unmanned aircraft systems (UASs) where the overall quantity and quality of evidence is less than ideal. This is compounded by concerns the roles of human operators in UASs qualitatively differ from those in manned aviation,

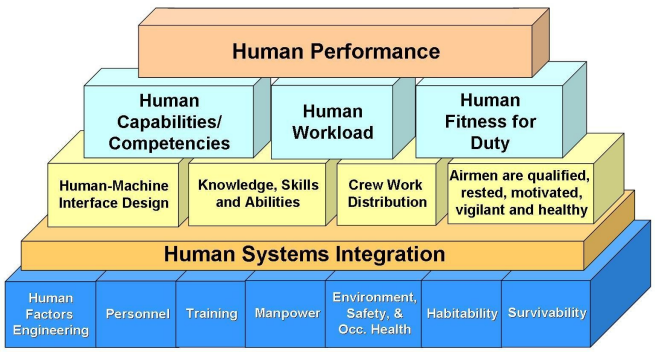

Figure 1. HSI Process Model for Human Performance

self-evident given we live and work in a resource constrained world where it is often not possible or practicable to ideally address each domain. For example, a program manager forced to accept shortfalls in cockpit design may plan for improved training or the selection of more capable individuals in order to maintain the desired level of performance (Figure 2). The HSI model also has utility in anticipating hazardous performance degradations in existing systems by providing a conceptual framework within which to search for uncompensated domain shortfalls. This is synergistic to efforts

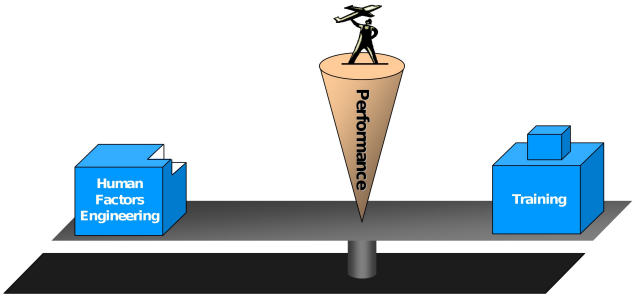

Figure 2. Using the HSI Model to Counter Domain Shortfalls

Risser and colleagues[6] proposed a 3-step process for joint UAS HSI issue identification and solution coordination (Figure 3) at a 2004 UAS human factors workshop. One of the initial process inputs is a systematic review of UAS mishaps tailored to specifically identify HSI breakdowns. The present study seeks to accomplish this by building off prior work analyzing UAS mishaps

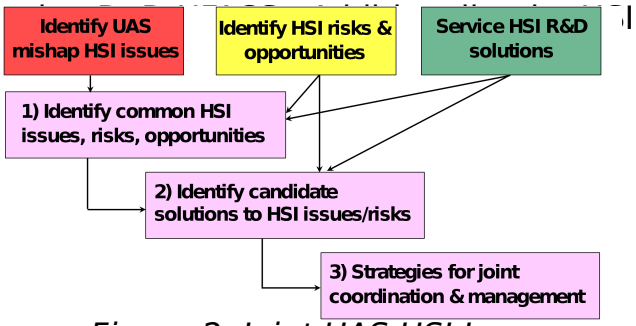
Identify UAS mishap HSI issues
Identify HSI risks & opportunities
Service HSI R&D solutions
1) Identify common HSI issues, risks, opportunities
2) Identify candidate solutions to HSI issues/risks
3) Strategies for joint coordination & management

Figure 2. Joint UAS HSI Issue Identification and Solution Coordination

Continued from page 5

Methods

The author and colleagues[8] previously conducted a 10-year cross sectional quantitative analysis of human factors in 221 U.S. Air Force, Army, and Navy/Marine class A-C UAS mishaps occurring during the period from fiscal years 1994-2003 using the DoD HFACS taxonomy. Linkages were created between DoD HFACS nanocodes and the 7 HSI domains outlined in the *Defense Acquisition Guide* (DAG):[2] human factors (engineering); personnel; training; manpower; environment, safety, and occupational health (ESOH); habitability; and survivability. The DAG further subdivided the human factors domain into 8 interfaces (e.g., functional, informational, environmental, cooperational, organizational, operational, cognitive, and physical) which were also mapped to DoD HFACS nanocodes. Service-specific logistic regression models were created using the HSI domains and interfaces as predictors of degraded human performance (e.g., operator error-related mishaps).

Results

Collectively, operator performance was a factor in 38.0% of DoD UAS mishaps. However, the frequency of UAS operator error-related mishaps differed significantly based on service: Air Force – 55.8%, Army - 31.4%, and Navy/Marines – 34.6%. Table 1 summarizes the HSI domains and human factors interfaces significantly associated with UAS operator error stratified by service. The service-specific models differed with regards to the HSI domains/interfaces retained although cognitive interfaces was present in all three models. The Army and Navy models were relatively homogeneous

Table 1. HSI Models Predictive of UAS Operator Error-Related Mishaps by Service

Model Variables	R^2 (p-value)
Air Force	
Human Factors Functional Interfaces Cognitive Interfaces Personnel Training	0.695 (<0.001)
Army	
Human Factors Cooperational Interfaces Cognitive Interfaces Physical Interfaces Training	0.856 (<0.001)
Navy/Marines	
Human Factors Environment Interfaces Cooperational Interfaces Organizational Interfaces Cognitive Interfaces Training	0.776 (<0.001)

This study suggests opportunities exist to jointly leverage work involving cognitive interfaces such as decision support systems, interface enhancements for maintaining situational awareness and mental models of the tactical environment (e.g., synthetic vision overlay), and provisions for knowledge generation, cognitive skills and attitudes, and memory aids.[2,4] Given the service-specific HSI models, it may be more useful at the present time to focus on HSI issues common to tactical (e.g., Army and Navy) versus strategic (e.g., Air Force) UASs rather than those common to all UASs. Using the former approach, additional opportunities exist to coordinate on HSI issues involving cooperational interfaces and the training domain as well as cognitive interfaces. This makes

of UAS mishaps resulting from operator error will move into the historical 60-80% range.[8,11]

Continued from page 6

as the types of UASs operated become more homogenous, making joint HSI issue coordination increasingly practical.

To this point, we've started with breakdowns in human performance and worked retrospectively to identify pre-existing HSI domain shortfalls. It is also possible to work prospectively starting at the level of the individual HSI domains and identifying potential future human performance challenges, in essence performing a hazard analysis. Proceeding in this manner, fairly dramatic changes are occurring in the personnel and training domains as the USAF works to establish a dedicated UAS operator specialty track not selected from the population of existing rated pilots. This has obvious performance implications given decreased operator training and initial experience levels. More broadly, however, there are very few studies addressing overall UAS operator knowledge, skills, and abilities on which to base selection and training decisions. Personnel and training issues must also be evaluated in light of the human factors engineering domain, namely ground control station (GCS) design. The GCS is the focus of ongoing research aimed at potential technological performance solutions, but significant debate continues over the most appropriate approach to GCS design. Advances in autonomous technologies are lessening the need for UAS operators to have traditional pilot skills and instead emphasize monitoring and collaborative decision-making skills. Yet high-level automation can adversely affect operator workload, degrade situational awareness, predispose to complacency, and degrade cognitive skills.[9] Additionally, multi-aircraft

baseline performance in current UAS crews, increasing the likelihood for operator errors, and are ripe targets for human performance interventions.[7]

In order to empirically address these human performance challenges, the 311th Performance Enhancement Directorate is managing an initiative to accomplish a series of front end analyses (FEAs) of USAF UAS crewmember positions. A FEA is a form of job or task analysis, but it is methodologically unique in that it starts with the mission objectives and works backward to examine the performance required to specifically meet those objectives. This approach has the advantage of avoiding describing performance which does not support the mission. The outcome of the FEA is documentation of the desired performance and identification of interventions (e.g., skills, knowledge, training, work environment improvements, and incentives) required to achieve this performance. The data in the FEAs will subsequently become the empirical evidence for:

- Developing specifications for the selection, initial certification, and recertification or accommodation of personnel (personnel domain),
- Validating the adequacy of training programs (training domain),
- Developing specifications for the redesign, enhancement, or both of the ground control station work environment (human factors engineering domain), and
- Prioritizing interventions to enhance operator performance (multiple domains).

The return of investment from the FEAs will derive from the ability to employ an evidence-based approach to assess and improve the outputs of the various HSI domains thereby maximizing UAS operator performance. As noted by Weeks, "because [UASs] are just beginning to be adapted into the U.S. military, human factors research is needed not only to help resolve the controversy over operator qualifications but also to support programs similar to those for manned aviation including physical standards [and training]."[10(p. 12)]

Continued from page 7

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Did You Know?.....

- The MANPRINT Practitioners' Workshop will be October 31 through November 2 at the Doubletree Hotel Crystal City-National Airport. We are just beginning the planning and development of the agenda – if there are any recommended subjects of discussion, please let us know through the contact information below.

- Mr. Bob Giffin has retired from his position at United States Army Combat Readiness Center.

- At the American Army Aviation Association Annual Conference, Gaylord Opryland Resort Convention Center, Nashville, TN (9-12 April 06) the MANPRINT Directorate and a representative from ARL-HRED, Fort Rucker, staffed the MANPRINT booth.

- Look for the MANPRINT Directorate to have a new website launched this summer. It will have a fresh new look and an improved way of maintaining upcoming events and recent news.

- The MANPRINT Directorate welcomes current MANPRINT-related news, information, and articles to use for publication in our MANPRINT Newsletter. Please contact Lynne Garrett, lgarrett@maxtc.com or Crystal McKay, crystal.mckay@hqda.army.mil for more information and submission guidelines.

MANPRINT Training Schedule

MANPRINT ACTION OFFICER'S COURSE (MAOC)

CLASS	START DATE	END DATE	LOCATION
2006-705	17 Jul 2006	21 Jul 2006	Fort Bragg, NC
2006-002	31 Jul 2006	04 Aug 2006	ALMC, Fort Lee, VA
2006-706	18 Sep 2006	22 Sep 2006	Huntsville, AL
2007-701	23 Oct 2006	27 Oct 2006	Fort Leonard Wood, MO
2007-001	22 Jan 2007	26 Jan 2007	ALMC, Fort Lee, VA
2007-704	05 Feb 2007	09 Feb 2007	Fort Bragg, NC
2007-705	07 May 2007	11 May 2007	Fort Leonard Wood, MO
2007-002	09 Jul 2007	13 Jul 2007	ALMC, Fort Lee, VA

MANPRINT TAILORED TRAINING (APPLICATIONS COURSE)

CLASS	START DATE	END DATE	LOCATION
2006-709	16 May 2006	18 May 2006	Fort Huachuca, AZ
2006-001	22 May 2006	24 May 2006	ALMC, Ft. Lee, VA
2006-706	06 Jun 2006	08 Jun 2006	Aberdeen Proving Ground, MD
2006-707	08 Aug 2006	10 Aug 2006	Warren, MI
2007-701	03 Oct 2006	05 Oct 2006	Fort Gordon, GA
2007-702	14 Nov 2006	16 Nov 2006	Fort Bliss, TX
2007-703	30 Jan 2007	01 Feb 2007	Fort Belvoir, VA
2007-704	20 Mar 2007	22 Mar 2007	Fort Rucker, AL
2007-001	30 Apr 2007	02 May 2007	ALMC, Fort Lee
2007-705	05 Jun 2007	07 Jun 2007	Rock Island, IL
2007-706	26 Jun 2007	28 Jun 2007	Aberdeen Proving Ground, MD
2007-707	31 Jul 2007	02 Aug 2007	Warren, MI
2007-708	18 Sep 2007	20 Sep 2007	Huntsville, AL

(POC: Mr. Pat Wilson, COM (804) 765-4373, DSN 539-4373)

MANPRINT INFORMATION

Articles, comments, and suggestions are welcomed and are to be submitted through the MANPRINT Contractor: MANPRINT Newsletter, Maximum Technology Corporation, 4910 University Square, Suite 4, P.O. Box 11817, Huntsville, AL 35814-1817; COM (256) 864-7630, FAX (256) 722-2149, E-mail: MANPRINT@hqda.army.mil

MANPRINT Web Site: http://www.manprint.army.mil

POLICY: Department of the Army, G1, ATTN: DAPE-MR, 300 Army Pentagon, Washington, DC 20310-0300, DSN 225-5848, COM (703) 695-5848.

DIRECTORY OF DESIGN SUPPORT METHODS: Defense Technical Information Center–MATRIS Office, DTIC-AM, NAS NI Bldg, 1482, Box 357011, San Diego, CA 92135-7011, DSN 735-9414, COM (619) 545-9414, E-mail: ddsm@dticam.dtic.mil, and web site: http://dticam.dtic.mil/hsi/

MANPRINT DOMAIN POCs

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The MANPRINT Newsletter is an official bulletin of the Deputy Chief of Staff, G1, Department of the Army. The Manpower and Personnel Integration (MANPRINT) program (AR 602-2) is a comprehensive management and technical initiative to enhance human performance and reliability during weapons system and equipment design, development and production. MANPRINT encompasses seven key domains: manpower, personnel, training, human factors engineering, system safety, health hazards and soldier survivability. The focus of MANPRINT is to integrate technology, people and force structure to meet mission objectives under all environmental conditions at the lowest possible life-cycle cost. Information contained in this bulletin covers policies, procedures, and other items of interest concerning the MANPRINT Program. Statements and opinions expressed are not necessarily those of the Department of the Army. This bulletin is prepared twice yearly under contract for the MANPRINT Directorate, G1, under the provisions of AR 25-30 as a functional bulletin.

READER'S RESPONSE

Use this space to record changes, additions or deletions. Send your information to the MANPRINT Contractor, Maximum Technology Corporation (MTC) by Fax (256) 722-2149 or Mail (fold on designated line and close (do not staple) with the MANPRINT Newsletter address on the Outside). If you are a MANPRINT POC for your organization, please check the MANPRINT POC block.

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